3 An Assessment of the Southern Wildland–Urban Interface

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3.1 INTRODUCTION

Severe wildfires in Florida in 1998 demonstrated the complexities that the wildland–urban interface presents for a diverse group of people who live and work there. These fires cost millions of dollars in suppression costs, reduced tourism, and damaged timber, businesses, and homes. Entire communities had to be evacuated, and many elderly people and others afflicted with respiratory illnesses needed medical attention. Forest ecosystems were endangered.

Shortly after these fires, the chief of the USDA Forest Service conducted a review of the South and concluded that the wildland–urban interface is a key issue for the region affecting the condition, health, and management of forest resources. The Southern Research Station and Southern Region of the USDA Forest Service, in cooperation with the Southern Group of State Foresters, responded by developing a southern assessment of wildland–urban interface issues, challenges, and needs. This chapter summarizes this assessment, titled *Human Influences on Forest Ecosystems: The Southern Wildland–Urban Interface Assessment* (Macie and Hermansen 2002).

3.1.1 The Wildland–Urban Interface

The South is experiencing unprecedented population growth, resulting in rapid land-use change and profound human influences on forest ecosystems. As a result, the goods, services, and management of these forests are altered. These areas of rapid change are referred to as the wildland–urban interface. The wildland–urban interface can be defined in many ways, from a variety of perspectives. For this assessment, we defined the wildland–urban interface as an area where increased human influence and land-use conversion are changing natural resource goods, services, and management.

Wildland fires that threaten lives and property are perhaps the most obvious problems being faced by residents in the wildland–urban interface, but there are other issues of equal importance. As the number of private forest landowners in the South is increasing and parcel size is decreasing, the challenges associated with managing small-scale parcels for a diversity of management objectives are growing. Other critical management challenges in the interface include watershed management and protection, nonnative species invasions, forest health, wildlife management and conservation, recreation demand, and many more.

3.1.2 A Southern Assessment

The South is undergoing change at a rate unlike any other time in its history. Although change has been a constant since people first settled in the region, the current rate, pattern, and permanence of this change are unprecedented. Humans are influencing surrounding forests in a variety of ways. The first section of the assessment describes some of these major influences, including population and demographic changes, economic and tax influences, and land-use planning and policy issues. The second section of the assessment relates how urbanization and other human influences are changing forest ecosystem structure, function, and composition. This section also summarizes major forest resource management and conservation challenges and social changes in the interface. The third and final section presents a case study using fire to show the interdisciplinary nature of wildland–urban interface issues, and describes major themes and needs of the interface.

The assessment covers the 13 southern states from Virginia to Texas (Figure 3.1). Although many studies have looked at individual wildland–urban interface issues across the U.S., few have been conducted in the South and from an interdisciplinary perspective. While the assessment demonstrates that the rate and extent of change in the South are greater than other regions of the U.S., many of the interface issues, themes, and recommendations are applicable to other parts of the U.S. and abroad.

An extensive literature search was conducted to determine the current state of knowledge on interface issues. This indicated where gaps in knowledge still exist and facilitated the identification of wildland–urban interface research and information needs. A series of 12 focus groups in six communities experiencing rapid growth was also conducted to help refine and validate interface issues presented in this assessment (see Box 3.1).

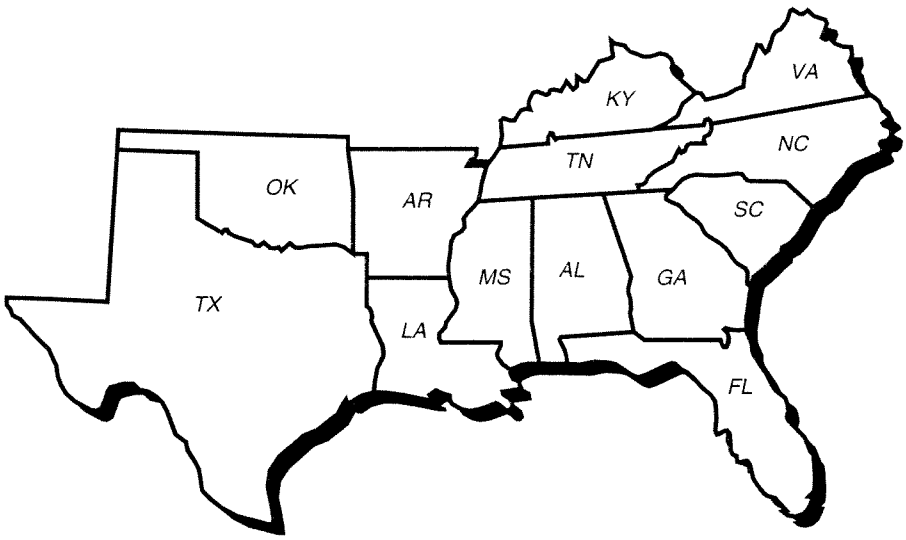


FIGURE 3.1 The 13 southern states covered by this assessment.

Box 3.1

ASSESSMENT FOCUS GROUPS

In May and June 2000, 12 focus groups were conducted in six southern states to better understand the wildland–urban interface and identify issues to be addressed in the assessment. The groups helped identify new tools, knowledge, and skills needed by natural resource managers, decision makers, and others affected by the changes occurring in the interface. A diverse group of people was invited, including planners, foresters, developers, firefighters, private landowners, local and state policy makers, and many more.

A facilitator asked the group members a series of questions about interface issues. Some example questions are:

1. Pretend you are a tour guide and describe the wildland–urban interface for me. What would we see, hear, and smell?
2. Describe factors that drive change in the interface areas you just described.
3. What are the key issues in the interface? What are the specific challenges you meet when attempting to manage resources in the changing wildland–urban interface?

For more information on the methodology used and the results, refer to Monroe et al. (2003).

3.1.3 PURPOSE

The main purpose of this assessment was to provide direction for establishing a program of research and technology transfer within the USDA Forest Service, which began in January 2002 in Gainesville, FL. The Southern Center for Wildland–Urban Interface Research and Information is addressing the need for new interface research, technologies, outreach programs, and educational material for managers, landowners, local governments, and others.

3.1.4 OBJECTIVES

The five main assessment objectives were to:

1. Explore the wildland–urban interface from an interdisciplinary perspective in order to understand the complexity and connectivity of interface issues.
2. Examine factors driving change in the interface, including population and demographic trends, economic and taxation issues, and land-use planning and policy.
3. Explore the consequences of this change on forest ecosystems, resource management, and social systems.
4. Identify gaps in our knowledge of interface issues to help us identify research and information needs.
5. Promote dialogue about and heighten awareness of interface issues among practitioners, researchers, and the general public.

3.2 FACTORS DRIVING CHANGE

3.2.1 POPULATION AND DEMOGRAPHIC TRENDS

The South's population is growing, moving, aging, and more culturally and ethnically diverse (Cordell and Macie 2002). Population growth in the South is increasing relative to other regions of the U.S. Between 1990 and 2000, the South's population grew 14 percent to 91 million residents and now accounts for 33 percent of

the national total. The South's population is projected to increase another 24 percent to 114 million people by 2020. Births, deaths, and net immigration are major determinants of this population growth. Most significant is the net immigration into the South from other countries, which amounted to almost 6 million people between 1981 and 1990 (Cordell and Macie 2002).

An increase in the number of people from other countries is also creating a more culturally and ethnically diverse society. The ethnic makeup of the South is projected to see large shifts by 2020, most notably among the Hispanic population (Table 3.1). Non-Hispanic whites are steadily becoming a smaller percentage of the total population (Woods and Poole Economics 1997). It is important that natural resource managers be aware of these shifts because people from diverse backgrounds and age groups have different perspectives, attitudes, and values with respect to the use of forests and other natural resources (Cordell et al. 2002). For example, in one study Mexican Americans rated "doing something with your family" and "doing something with your children" significantly higher than non-Hispanic whites as favorite outdoor activities (Gramann and Floyd 1991).

Another important component of social change in the region is the aging of the population. The median age of the U.S. population has increased steadily from 18.9 years in 1850 to 32.8 years in 1990. In the South, median ages currently range from a low of just under 34.5 in Texas to a high of over 42 in Florida. This trend has important implications for forest ecosystems since forested and other natural lands are attractive retirement destinations (Cordell and Macie 2002).

More dramatic than these population dynamics is the conversion of rural and forestland to urban uses and the sprawling pattern of urban growth in the South. Increased numbers of people create more demand for housing, businesses, and transportation systems. This leads to greater urban growth and expansion of the wildland–urban interface and results in increased pressure on the forest resources found there (Cordell and Macie 2002).

Between 1992 and 1997, six of the 10 states in the U.S. with the highest levels of rural to urban conversion were in the South. Annually, more rural acreage is converted to urban uses in the South than any other region of the U.S. Metropolitan counties are accounting for about 82 percent of all population growth and today over 80 percent of the U.S. population is urban. This suggests that the urban constituency, which increasingly values forests more for noncommodity benefits than traditional forest products, will exert the greatest influence on national and state policies affecting natural resources and management of public land. Targeting the urban public for natural resource information and technology transfer programs, therefore, may have the greatest influence on the creation of public policies that support natural resource management and conservation (Cordell and Macie 2002).

Of the South's approximately 432 million acres of rural land, 78 percent is in corporate or individual private tracts. Individual private ownership is the region's primary ownership category, with 66 percent owning less than 500 acres (Figure 3.2). Also, of these ownerships the number of absentee vs. resident landowners is increasing, primarily motivated by recreation and speculation. Landowners have a variety of reasons for owning rural land (Figure 3.3), ranging from wanting to live in a rural environment to providing wildlife habitat (Teasely et al. 1999). Diverse management options for smaller tract sizes that meet a variety of landowner objectives are not currently available or must be adapted from large-scale practices to these smaller sizes.

TABLE 3.1
Projected Shift in the Ethnic Composition of the South

	Percentage of the Southern Population	
Race	1990s	2020
Non-Hispanic whites	72.4	61.0
African American	16.7	19.5
Hispanic	8.9	16.2
Asian and other races	2.0	3.0

Source: Woods and Poole Economics, Inc. (1997).

3.2.2 Economic and Tax Issues

Economic trends and tax policies considerably influence the rate of change in land use in the wildland–urban interface. Some economic and tax policies can accelerate development, while others help to shape development to meet the needs of a growing population while retaining as much land as possible in a rural condition (Moffat and Greene 2002).

The South's economy has evolved from one based primarily on agriculture and natural resource extraction to one that is diversified, including the service sector, industry, and computer manufacturing. Since 1978, nearly four of every 10 jobs gained in the U.S. were in the South, and the number of jobs has increased by 54 percent in the South compared to 38 percent for the rest of the nation (Moffat and Greene 2002). This change has helped promote the immigration and migration to the South discussed previously.

Efforts to improve the southern economy have contributed to several economic trends affecting change in the interface. For example, since local governments receive most of their funding from property and sales taxes, they have little reason to attempt to limit land development in their jurisdictions. This can lead to overzoning for development by local governments seeking to maximize their tax revenue. For example, in Loudoun County, Virginia, current zoning allows approximately 50,000 new housing

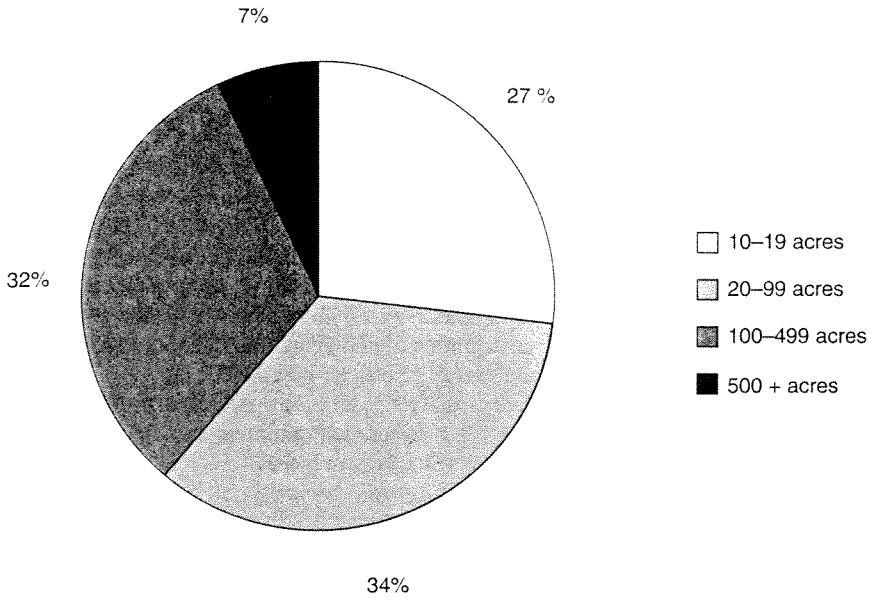


FIGURE 3.2 Percentage of individual nonindustrial landowners by the size of tract owned. (Adapted from Cordell and Macie 2002.)

units to be built, while the current demand is only about 3000 units per year (Lindstrom 1997).

As cities grow, the interface becomes more attractive to develop and inhabit. Subdivision of the land can be quite profitable for rural landowners, and often, as land values and property taxes rise, landowners may be forced to subdivide to keep any land at all. Water, sewer, garbage, fire, schools, and other services must be provided to new interface residents. Larger roads must be constructed to accommodate the increased traffic. Some people can work in the tranquility of their own homes, while others must commute longer distances. With time, these interface areas start to take on the qualities that people were trying to escape, and they therefore may seek a new interface, repeating the cycle (Moffat and Greene 2002).

Land development in the wildland–urban interface generates less revenue than municipal governments must pay to extend services to these areas. Several "cost-of-community services" studies have shown that local governments spend between 15 and 80 cents in services for every dollar of tax revenue generated by farms and forests, between 15 and 47 cents for every dollar of revenue generated by commercial development, and between $1.04 and $1.55 for every dollar collected for residential development! Moreover this does not include the nonmonetary values associated with maintaining land in agriculture and forests, such as reducing stormwater storage requirements that could save governments millions of dollars (Moffat and Greene 2002).

Nonindustrial private forest landowners face many economic pressures from federal and state taxes. Although many taxes affect land-use change in the interface, perhaps most notable are the federal income tax and the federal and state estate taxes. Other taxes that affect rural landowners to various degrees are state income taxes, property and yield taxes, and severance taxes. The federal income tax has the greatest economic effect of any

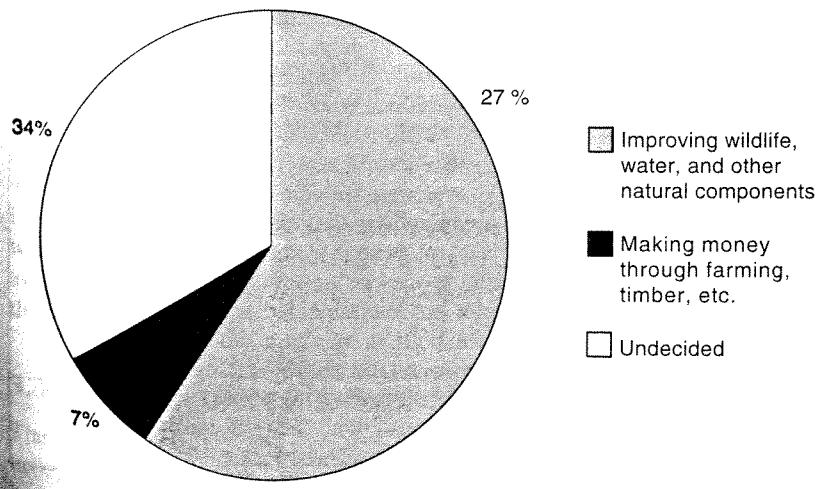


FIGURE 3.3 Percentage of nonindustrial private landowners by land management emphasis. (From Cordell and Macie 2002.)

tax on working land in the South because the rate is uniform across the region and is high compared to most other taxes (Greene 1995, 1998). This increases the costs of owning or managing rural land and therefore influences production decisions (Gregory 1972). It can create pressures for landowners to sell their land, particularly if the cost of keeping land in its present use is increasing.

Estate and gift taxation is another area of concern for landowners and foresters throughout the U.S. Federal and state death tax burdens resulting from insufficient estate planning can cause disruptions in forest management, abandonment of timber production by heirs, and fragmentation of ownerships. Greene et al. (2001) estimated that, nationwide, 2.6 million acres of forest must be harvested and 1.3 million acres must be sold each year in order to pay the federal estate tax.

Several tax and economic tools, such as conservation easements (see Box 3.2) and forest banks (see Section 3.3.2), can help landowners maintain forestlands at the interface. There are also many tax incentives, such as income averaging and permitting the immediate deduction of reforestation expenses, which could help reduce the federal income tax burden. Although these and other tools provide some assistance, they are for the most part still underutilized or of limited effectiveness without the help of policy makers to integrate and coordinate federal and state tax codes and landowner assistance programs (Moffat and Greene 2002).

3.2.3 Land-Use Planning and Policy

Land use in the wildland–urban interface is also greatly affected by current land-related public policies at federal, state, and local levels (Kundell et al. 2002). At the federal level, policies often appear to be in a tug-of-war. Some federal policies have created incentives for development and changes in land-use patterns, such as the federally subsidized National Interstate Highway System. On the other hand, there are also numerous federal policies and programs, such as the Clean Air and Clean Water Acts, that attempt to conserve and protect natural resources and contain provisions for limiting certain land uses.

Authority to guide land-use decisions lies mainly with the states, which may choose to give this control to county or municipal governments (Kundell et al. 2002). Some of the main state policies and programs affecting land use in the interface are:

- Forest practice ordinances, which act to protect environmental quality and local government investment in roads, bridges, and highway infrastructures. These ordinances are often enacted in response to local concerns over rapid land development, and range from simple tree replacement standards to comprehensive ordinances addressing natural resource issues (USDA Forest Service 2002).

Box 3.2

Existing Land-Use Planning and Policy Tools

Many tools currently exist for protecting natural resources within the interface:

- *Technologies*, such as Geographic Information Systems (GIS), can aid in planning land use and analyzing land-use trends. For example, the GIS-application CITYgreen, developed by American Forests, allows users to calculate the environmental and economic benefits of forests and trees (American Forests 2002).
- *Land-related policies* — The following growth management policies can be used in the interface (Daniels 1999):
  - *Smart growth programs*, which include a range of approaches that promote more efficient and compact urban development patterns. An example is urban growth boundaries, which encourage compact development and provide an appropriate direction for expansion of development over time.
  - *Alternative zoning ordinances*, which allow planners to design developments that better fit the land and to set aside more green space. One example is cluster developments, which are subdivisions in which development must be placed on a portion of the parcel and the rest must remain in undeveloped open space.
  - *Conservation easements*, which are voluntary legal agreements between a landowner and another party that restrict the development of a tract of land and provide tax benefits that can help to maintain land in rural uses.
  - *Purchase-of-development-rights (PDR)* programs, which enable the preservation of farm and forestland by giving the state and local governments the ability to purchase development rights (conservation easements) from landowners and restrict the land to farm, forestry, and open-space uses.
  - *Transferable-development-rights (TDR)* programs, which enable preservation of sensitive lands by moving development potential from one tract of land to another, unlike the outright retirement of development rights under PDRs.
  - *Land trusts*, which are private nonprofit organizations that can either receive donations of property, conservation easements, and money or buy property and conservation easements. Land trusts play a useful role both in working with landowners to preserve land and by acting as intermediaries between government agencies and landowners who share a common interest in keeping the land intact.

- Statewide growth management plans, which establish statewide goals and policies, create regional agencies to review and coordinate local plans, and require local governments to prepare plans that implement statewide goals. All too often, however, lack of local government cooperation prevents achievement of the plans' goals. In Florida, for example, local zoning decisions favor low-density, sprawling development, even though these practices are inconsistent with the statewide growth management plan (Nelson et al. 1995).

- State infrastructure policies, which often contribute greatly to problems with land development patterns in the interface. For example, state transportation departments can build roads without regard for local plans, and state community infrastructure funding often emphasizes new development over restoring older systems.

Local governments use zoning ordinances as the primary tool when making land-use decisions. There are many examples, however, of how local zoning policies indirectly promote growth. Often, local governments try to reduce housing density by increasing lot size. This policy actually increases land consumption, causing development to sprawl out over the landscape (Kundell et al. 2002).

Current land-use policies are largely ineffective for managing growth because they are based on traditional programs that were not designed for that purpose (Kundell et al. 2002). Zoning ordinances, for example, were designed to protect private property values and public investment. Complications also arise from the overlapping of multiple federal, state, and local jurisdictions. As a result, various levels of the government are independently making land-use decisions without any common understanding of what long-range growth management goals each government level wants to achieve. There is also no common approach for addressing environmental issues that cross jurisdictional boundaries (Kundell et al. 2002).

Fortunately, a broad array of policies, programs, and other tools exist to help guide and control growth in the interface (see Box 3.2). With the implementation of these tools, natural resource protection and management in the wildland–urban interface can be greatly improved. However, natural resource managers and the public, as well as state and local officials, need to become both more aware that these tools exist and be more willing to put them into practice.

3.3 CONSEQUENCES OF CHANGE

The effects of urban development on southern forest ecosystem goods and services are profound. Resource professionals face difficult challenges in their attempts to manage these forests and to minimize the changes to natural resources that are occurring.

3.3.1 URBAN EFFECTS ON FORESTS

The most obvious direct effects of urbanization and other human activities on forests are the reduction of total forest area (Table 3.2) and fragmentation (Zipperer 2002), which is a deforestation process that subdivides forest cover into smaller and more isolated forest parcels. Rates of forest loss are fastest near major urban centers, along major transportation routes, and near recreational areas such as national parks (Boyce and Martin 1993).

Additionally, humans indirectly alter forest ecosystems by modifying hydrology, altering nutrient cycling, introducing nonnative species, modifying disturbance regime, and changing atmospheric conditions. These changes significantly affect forest health and modify the goods and services provided by forest ecosystems (Zipperer 2002).

Fragmentation has significant effects on biodiversity (Zipperer 2002). The loss of forested corridors can create isolated wildlife populations and consequently reduce genetic flow. This reduction can potentially lead to inbreeding and local extinctions. Fragmentation alters the physical environment and biotic communities of forests, including greater temperature fluctuations and increases in parasitism and predation. Forest patches have an increase in edge habitats, which can change the species composition by favoring edge species, such as raccoons and deer, over species that require interior conditions, such as ground-nesting birds.

Besides reducing and fragmenting forest cover, urbanization alters water flows and significantly affects aquatic habitats (Zipperer 2002). Impervious surfaces increase surface runoff, changing streambank stability,

TABLE 3.2
Tree Canopy Losses in Selected Areas in the South

Location	Forested Area Loss (thousands of acres)	Time Period	Tree Canopy Loss (%)
Atlanta metropolitan area	1747	1974–96	26
Chattanooga, Tennessee	110	1974–96	21
Houston metropolitan area	692	1972–99	8
Roanoke, Virginia	313	1973–97	9
Fairfax County, Virginia	125	1973–97	20

Note: Because measurements of canopy losses and fragmentation are scale dependent, a comparison across different studies is difficult. Analyses by American Forests (2002) were used because the same protocol was employed to analyze each region. A 30-m Landsat pixel was classified as forestland if it had at least 50 percent tree cover. The use of these analyses, however, does not imply an endorsement of techniques or models developed to obtain these values.

Source: Zipperer (2002).

water quality and quantity, and biodiversity of aquatic systems. Besides the increase in impervious surfaces, urbanization also often results in channelized streams, drained wetlands, and increases in the amounts of pesticides and nutrients found in streams. Development often occurs in the headwaters of streams and rivers, endangering local species that are extremely sensitive to adverse environmental changes.

Forests in urban landscapes differ environmentally, compositionally, and structurally from rural forests (McDonnell et al. 1997) (Figure 3.4). Forests do not need to be disturbed directly by development to be affected. Adjacency to urban land uses can create changes in forests over time, such as by exposure to nonnative species (Zipperer 2002).

In general, as one moves along a gradient from rural to urban ecosystems, species richness of plants increases, but it decreases for mammals, birds, amphibians, and reptiles (Kowarik 1990). Also along this continuum, the number of native species decreases, while nonnative species increase. These forest alterations are a result not only of urbanization but also of past and current agricultural and forestry practices (White and Wilds 1998). Altered forests are much more susceptible to the invasion of nonnative species because of modified soils and the absence of natural plant and animal predator species. Even native species in high population densities can affect ecosystem composition and structure (Zipperer 2002). Increases in the whitetailed deer (*Odocoileus virginianus*) population in the South, for example, have resulted in denuded understory vegetation, which significantly affects the breeding success of groundnesting bird species.

With increased urbanization also comes an increase in air pollutants, such as oxides of nitrogen (NO_x) and sulfur (SO_x) and tropospheric or ground-level ozone (O_3). Although these pollutants occur naturally, human activities are increasing their presence in the atmosphere (Zipperer 2002). The highest concentration of SO_x in the U.S. was found in a spruce forest in the Appalachian Highlands (Johnson and Lindberg 1992). At high concentrations, these pollutants can change ecosystem processes, damage plant tissue, and make forests susceptible to other environmental stresses (Berish et al. 1998).

Although addressed here independently, all of these urban effects act together. For example, atmospheric deposition alters nutrient availability in the soil and damages plant tissue. These effects subsequently make plants more susceptible to pests and pathogens (Zipperer 2002).

A healthy forest ecosystem is one that is free of distress syndrome, which refers to the ability of an ecosystem to recover naturally. The many direct and indirect effects of urbanization make forests vulnerable to distress syndrome. An integrative and interdisciplinary approach is necessary to address urban effects on forest health. The approach must account for the complexity of interactions among the social, ecological, and physical components of an ecosystem (Zipperer 2002).

3.3.2 Challenges to Forest Resource Management and Conservation

As previously discussed, urbanizing forest ecosystems are changing in their structure, composition, function, and processes. Additionally, forest tract size is decreasing, the number of owners is increasing, and forest management preferences are more diverse. These changes set the stage for new challenges, as well as new and innovative approaches, to forest resource management in the interface (Duryea and Hermansen 2002). Changes and challenges associated with the management of water resources, traditional forest products, fire, recreation, and wildlife are covered in this chapter of the assessment.

3.3.2.1 Water Resources

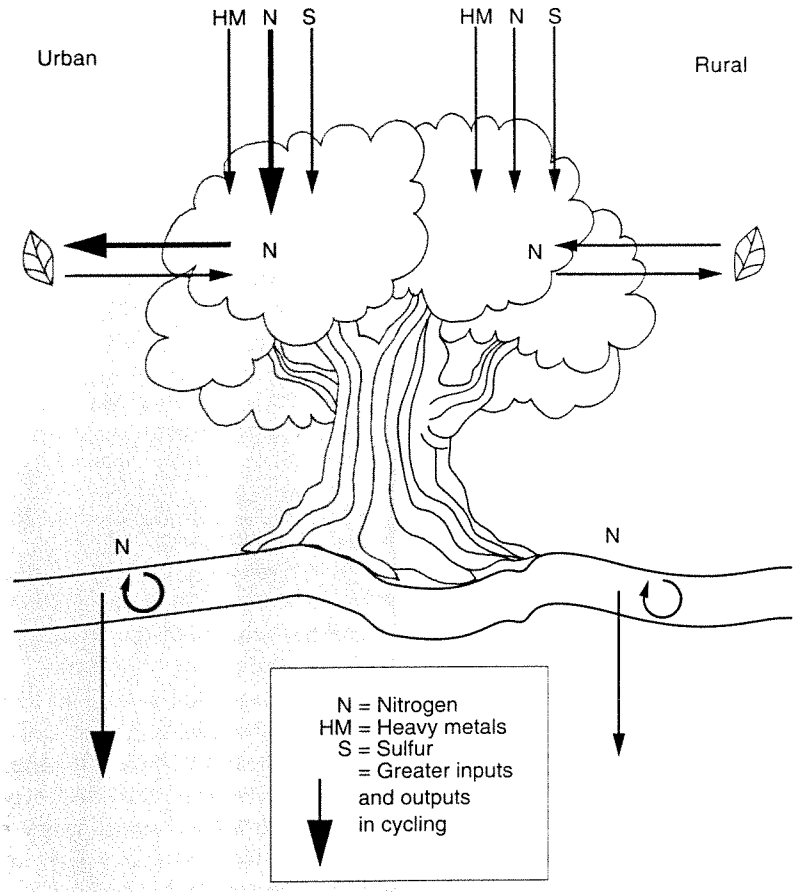
The management of water resources for quantity and quality in the urbanizing environments of the South is a complex task. A growing southern population requires increasing supplies of water; yet, more and more people are settling and recreating in primary watersheds of large cities (Minahan 2000). These increasing demands for water bring more complex issues over allocation of water for a variety of purposes, such as water-based recreation and adequate water supplies for wildlife and aquatic species habitat (Sedell et al. 2000) (Figure 3.5).

Human health concerns from polluted water sources is another important water resource issue. Municipal waste facilities in rapidly developing areas face difficulties with handling and treating increased waste loads, and sewage overflows may occur after heavy rainfalls. Septic tanks are often placed at high densities in the interface; they are extremely vulnerable to failures and are a chief contributor to fecal coliform contamination (Minahan 2000). Nonpoint source pollution, such as farm and stormwater runoff, is difficult to trace to its origin and is the cause of approximately 50 percent of water pollution problems in the U.S. (U.S. Environmental Protection Agency 1992).

Rather than concentrating on separate pollution dischargers and managing within the constraints of political boundaries, watershed management takes a "holistic" approach to managing water quality and is critical for effective water management (Rubin et al. 1993). This approach provides a framework for designing the optimal mix of land covers to minimize the effects on water resources and for coordinating management priorities across landownerships.

3.3.2.2 Traditional Forest Products

Southern forests are an important national source of timber, making up 40 percent of U.S. timberland (Faulkner et al. 1998). Management and conservation of these forests,



Urban		Rural
+	Soil temperature	−
+	Soil hydrophobicity	−
−	Microinvertebrates	+
+	Earthworms	−
−	Fungal hyphae	+
+	Nonindigenous plants	−
−	Stem density	+
−	Leaf litter depth	−
+	Decomposition	−
+	Nitrogen mineralization	−
+	Nitrification rates	−

FIGURE 3.4 Generalized illustration depicting structural and functional differences of forests in urban and rural landscapes having similar physical environments and species composition. (From Zipperer 2002.)

however, are increasingly difficult in the interface. The cost of land near metropolitan counties is high, thus making the production of timber from forests on these lands expensive. This can discourage landowners from making investments in forestry in these areas. Selling and subdividing the land can be more profitable, and the rapidly changing land-use patterns characteristic of the interface may also discourage landowners from making long-term investments in forestry.

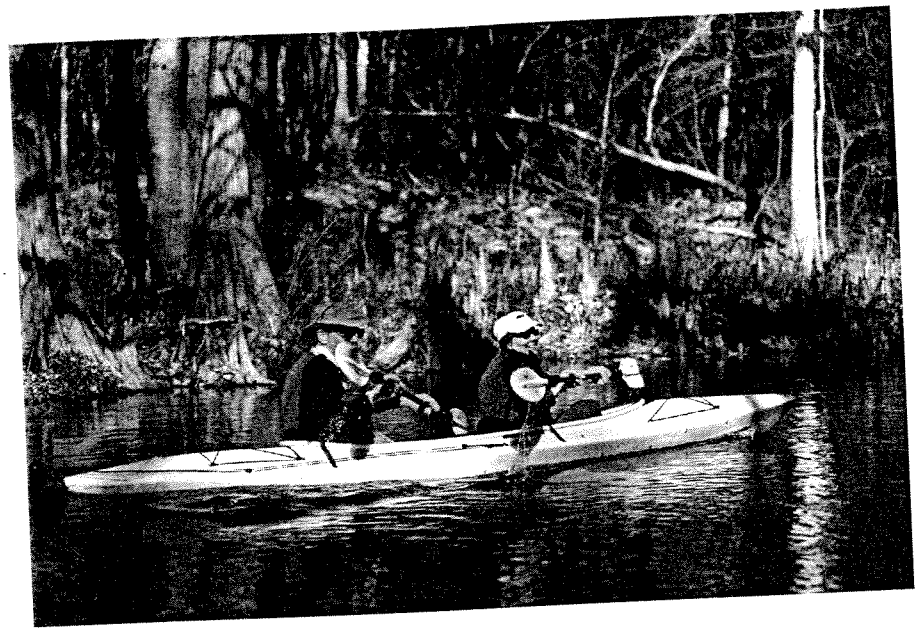


FIGURE 3.5 As human demands for water and water-based recreational opportunities increase, concerns for providing enough water for wildlife and aquatic species also grow. (Photo by Larry Korhnak.)

In the interface, closer public contact with forestry practices provides more opportunities for conflict. Opposition to the use of herbicides, prescribed burning, and other aspects of forestry operations can result in regulations that affect the quantity of timber available and the costs of transporting it. Forest management practices adapted to the special conditions and human influences of the interface are thus necessary (Duryea and Hermansen 2002). Examples include the use of partial cuts and limited use of herbicides close to public areas (Bradley 1984). Where timber production is not possible, nontimber commodity products (e.g., pine straw, medicinal plants) may be a viable alternative for landowners, especially for owners of smaller tracts.

Coordinated forest management across ownerships can help ensure healthy ecosystem function and provision of ecosystem goods and services. Partnerships among private landowners and organizations can help overcome the challenges of managing on a landscape scale (Duryea and Hermansen 2002). For example, by forming partnerships with private landowners, The Nature Conservancy's Forest Bank aims to protect the ecological health and natural diversity of working forests while ensuring long-term economic productivity (Dedrick et al. 2000).

3.3.2.3 Fire

Decades of fuel buildup and increases in the number of people in the interface have created many challenges for fire agencies across the South and the nation. The ability to use prescribed fire to enhance ecological processes is increasingly difficult, while the challenges associated with preventing and suppressing wildfires have increased. Negative public opinion regarding prescribed fire is one of the biggest obstacles that fire agencies must overcome. People may not understand the benefits of fire or may be concerned about public health and safety.

For these reasons, fire management cannot be the same in the interface as in rural areas. Different firing techniques and ignition patterns may be needed. Weather and fuel characteristics that are optimal in rural areas may not be practical in the interface due to concerns over excessive smoke production. Thus, smoke management becomes a priority because of health, safety, and liability concerns (Duryea and Hermansen 2002).

Fire protection agencies are charged to first protect human life and property, then natural resources. The problem with this is that forest fire suppression personnel do not usually have sufficient training in structural firefighting, and municipal fire departments are not typically equipped or trained for wildland fire suppression (Davis 1986). A challenge in the interface lies in combining firefighting expertise in both areas and providing cross-training opportunities (Duryea and Hermansen 2002).

3.3.2.4 Recreation

Recreation is an increasingly significant part of southern lifestyles. However, opportunities for recreation, particularly on nonindustrial private forestlands, are decreasing. This puts considerable pressure on public land managers to provide recreational opportunities for a diverse spectrum of users and to maintain the quality of natural resources on the site (Duryea and Hermansen 2002). This is especially true when these lands are close to large urban centers where recreational opportunities in inner cities are declining.

As previously discussed, the South holds an increasingly diverse population. Recreation managers must consider the needs and expectations of the different groups using wildland–urban interface recreation sites. They

must also possess the ability to communicate with diverse user groups who have different perceptions and values regarding land management.

3.3.2.5 Wildlife

The most significant wildlife management challenge in the interface is conserving, managing, and restoring wildlife habitat (Duryea and Hermansen 2002). Fragmentation of forests has created many unconnected patches of habitat. Utilizing corridors to connect small forest patches to larger reserves is especially valuable for wildlife. Site history, adjacent land-use types, and current influences should be taken into account when developing wildlife plans (Nilon and Pais 1997).

In the interface, some residents enjoy closer contact with wildlife, while others find this a nuisance. Balancing desires of residents to be close to wildlife with their desire to avoid nuisance and human health problems, such as transmission of Lyme disease from deer ticks, is a major wildlife challenge in the interface (Duryea and Hermansen 2002).

Nonconsumptive uses, such as wildlife viewing (Figure 3.6), are increasingly popular while consumptive uses, such as hunting, are declining (Cordell 1999). Being aware of local public attitudes toward wildlife management and conservation and incorporating both consumptive and nonconsumptive uses into management strategies are important for wildlife managers in the interface (Duryea and Hermansen 2002).

3.3.3 Social Consequences of Change

Social consequences are at least of equal importance to the environmental consequences of change in the interface. Economic, political, and community and landowner consequences of change are covered in this chapter.

3.3.3.1 Economic Consequences

As the rural forest transforms to an urban one, the economics of land management change (Hull and Stewart 2002). The perceived benefits of trees change and perhaps increase, as do the costs of planting and maintaining them (Dwyer et al. 2000). Decisions over whether and when to harvest trees are more complex in the interface because of community members' concerns about environmental quality and forestry practices, such as large-scale clear-cutting.

It also appears that urbanization reduces timber supply, increases harvesting costs, and decreases the profitability of timber production (Barlow et al. 1998; Wear et al. 1999), although much still remains to be known. Some studies suggest that nontimber commodities, such as fruits and medicinal herbs, can generate more money per acre in the interface than do rural lands growing traditional forestry crops. This money can help supplement family income and even help to retain land in forests that might otherwise be subdivided (Hull and Stewart 2002). Jobs follow people to the interface, providing additional opportunities to supplement household incomes.

3.3.3.2 Political Consequences

Interface forests differ from rural forests in the number and complexity of political issues affecting them (Hull and Stewart 2002). Land-use decisions tend to be more contentious and attract more attention than those in rural areas. Public participation also tends to be more abundant and diverse. Typically, with new owners and neighbors, decision making processes become more formalized. New owners may give more emphasis to environmental concerns than do longtime residents, although they may not have the personal community contacts that can help to influence land-use decisions. They do, however, tend to have more contact with national and regional organizations and insist on more formal procedures than long-term residents (Smith and Krannich 2000). This can have long-term benefits for a community, although decision making becomes more complex (Hull and Stewart 2002).

3.3.3.3 Community and Landowner Consequences

New forestland owners often have little contact with the professions that traditionally offer management advice, turning more toward garden care professionals and landscape architects for information, and possess different values and management objectives from longterm residents. Traditional methods of providing forestry advice, such as forest management plans, may not be effective for these new owners (Hull and Stewart 2002).

Community quality of life is also affected by settlement of interface forests. Increased development in the interface can bring increased access to health care, education, and jobs. Being closer to nature and farther from urban stressors is an accepted benefit of living in the interface, although increasing population density can generate the very qualities that were supposedly left behind in the urban environment and can encourage migration to even more remote areas. Finding an acceptable balance between these social costs and benefits is an ongoing challenge (Hull and Stewart 2002).

3.3.3.4 Needs of Natural Resource Professionals

Natural resource professionals need many new skills and tools to remain effective in the changing environment of the interface. They need new methods for communicating with landowners and distributing forestry advice. They need new skills, such as techniques for managing forests on small scales. They must also work effectively with the

FIGURE 3.6 Birdwatching is an increasingly popular outdoor recreation activity. (Photo by Larry Korhnak.)

TABLE 3.3
A Selected History of Wildland–Urban Interface Fires in the U.S.

Location	Year	Structures Lost (number)	Area Burned (acres)
Pine Barrens, NJ	1963	383	1,83,000
Laguna, CA	1970	382	1,75,425
Sycamore, CA	1977	234	805
Panorama, CA	1980	325	23,600
Palm Coast, FL	1985	99	13,000
Burke County, NC	1985	76	2,000
Onslow County, NC	1986	0	73,000
Monterey County, CA	1987	31	160
Nevada County, CA	1988	90	33,500
Sisters, OR	1990	22	3,300
Paint Cave, CA	1990	641	4,900
Oakland Hills, CA	1991	2,900	1,500
Chelan County, WA	1992	32	2,400
Craven County, NC	1994	0	24,600
Millers Reach, AK	1996	344	37,336
Poolville, TX	1996	141	16,000
State of Florida	1998	330	5,00,000
Juniper, CA	1998	44	6,000
St Lucie, FL	1999	43	759
Colbert County, AL	1999	20	3
Los Alamos, NM	2000	235	47,650
Russell County, AL	2000	6	4
Chambers County, AL	2001	2	30
Talledega County, AL	2001	1	347

Source: Monroe (2002).

large number of stakeholders with diverse values and interests (Hull and Stewart 2002).

Building partnerships is an important aspect of interface management. Natural resource professionals must become involved with the institutions that influence the management and development of interface forests. They need mechanisms that encourage and enable crossboundary ecosystem management. Additionally, resource professionals need a new language and conception of forestry that incorporates the understanding and concerns of the new owners and neighbors of interface forests (Hull and Stewart 2002).

3.4 MAJOR THEMES AND NEEDS

3.4.1 FIRE

Fire is but one of many important issues in the interface; yet, it is the one that attracts the most attention. Although fire was already mentioned in Section 3.3.2, here wildland–urban interface fire is used as a case study to reinforce the concepts brought up throughout the assessment and demonstrate how ecology, resource management techniques, economics, public policy, and demographics influence efforts to manage and protect both people and natural resources. Fire concerns cannot be resolved solely from a natural resource perspective. Using information and perspectives from each discipline, we can come up with better solutions to wildland–urban interface challenges (Monroe 2002).

At one time, wildland fire was not a problem in the South. To the contrary, it was considered a normal event or fire was set intentionally by Native Americans and early European settlers to improve wildlife habitat and clear land for cultivation. It is no longer possible, however, to let fires run their course. There are small towns, timberlands, vacation homes, and ranchettes in what were formerly wildland areas. The protection of human lives and investment necessitated the purposeful exclusion of fire from the South. Although this strategy successfully protected many lives and structures, it created huge fuel loads and increased the risk of catastrophic fires. Also, as more people live in the interface, the chances of a fire being ignited have increased. A selected history of wildland–urban interface fires in the U.S., provided in Table 3.3, demonstrates the scope and breadth of the problem.

3.4.1.1 Ecological Structure and Function

Many southern forest ecosystems have developed adaptations to fire. Longleaf pines, for example, have a thi

bark that insulates and dissipates heat, a grass stage to protect the bud, and a substantial root system that allows it to grow quickly above the ground fire zone (Myers and Ewel 1990). The purposeful exclusion of fire in the South has led to huge fuel buildups and the encroachment of plant species not tolerant of fire. This has resulted in high-intensity fires that can kill even large, mature trees, despite these adaptations. Frequent fires can help maintain healthy southern forests by providing ecosystem services such as releasing nutrients, scarifying seeds for germination, and releasing natural fertilizers such as ash and carbon (Brennan et al. 1998).

3.4.1.2 Natural Resource Management

Prescribed fire is one resource management tool that temporarily reduces heavy fuel loads in the interface and helps maintain healthy, diverse forests (Figure 3.7). However, there are concerns about air quality and public safety from the smoke produced during the fires. Where prescribed fire is not an option, alternatives such as mechanical reduction and herbicide treatment have been explored. These options, however, may not provide the same benefits for forest health as prescribed fire. Additionally, herbicide use may be even less acceptable to the public than fire (Monroe 2002).

3.4.1.3 Demographics

Interface residents are quite diverse — retirees, exurbanites, vacation, or weekend residents — representing a variety of ethnic and cultural backgrounds. Thus, not surprisingly opinions and attitudes about wildland fire vary from group to group. For example, English- and Spanish-speaking Florida residents who were recently exposed to wildland fires differed in their knowledge and perception of fire risk (Loomis et al. 2000). New residents who move to the interface may not be aware of the wildland fire risk. It is therefore important for natural resource managers to understand whom they are talking to when communicating about fire in the interface (Monroe 2002).

3.4.1.4 Economics

It is quite expensive to suppress and recover from interface fires. Because of the high housing densities in the southern interface, agencies must suppress fires at great cost, and any wildland fire is likely to put interface homes at risk. One complex of fires near Orlando, Florida, in 1998 cost over $5 million in suppression in less than 3 weeks. Additionally, the cost of conducting prescribed fires is much higher in the interface than in the wildlands because more preparation and public contact are needed (Greenlee et al. 1999).

3.4.1.5 Land-Use Planning and Policy

There are a variety of policies and recommendations about wildland fire suppression, the use of prescribed fire, zoning, firewise landscaping, and building construction. For example, Flagler County, Florida, which had a countywide evacuation during the 1998 wildland fires, enacted an ordinance requiring brush mowing and selective thinning of mature pine trees (Flagler County Ordinance No. 98-14). Because of liability issues related to smoke, several Florida counties have adopted ordinances requiring that prospective homebuilders be told about the use of prescribed fire in nearby state-owned natural areas (Wade and Brenner 1995). Florida's Certified Prescribed Burning Program [Florida Statute 590.125 (3)(b)] requires written prescriptions for each burn and protects the burner from liability unless gross negligence is proven. Successful interface policies will be ones that the public supports (Monroe 2002).

FIGURE 3.7 Prescribed fire is a fuel reduction method that can help reduce the risk of catastrophic wildfire in the interface. (Photo by Larry Korhnak.)

3.4.2 Assessment Themes

Throughout the course of this assessment, many themes emerged, crossing disciplinary boundaries. These themes were narrowed down to four principal areas that helped us to identify corresponding research and information needs in the interface.

3.4.2.1 Wildland–Urban Interface Issues Are about People

Wildland–urban interface issues are about people and their relationship with and effect on natural resources. Public perceptions, values, and attitudes affect land use and ultimately determine future forest management strategies and policies in the interface. Research can help us better understand and predict the intricate and complex relationship between people and natural resources.

3.4.2.2 Public Policy Plays an Important Role in Creating and Solving Interface Problems

Some public policies act to protect and conserve natural resources in the interface, while others provide incentives for urban development. Some policies may conflict with one another. Obtaining an understanding of and becoming involved with the various policies and decision making processes unique to the interface are critical for natural resource professionals. Natural resource professionals must also become involved by providing the best available scientific information to policy makers.

3.4.2.3 Interface Issues Are Interdisciplinary

This assessment demonstrates the crosscutting nature of interface issues and the need for interdisciplinary approaches in solving the complex issues within the interface. Building relationships across various disciplines and professions improves opportunities for addressing interface issues.

3.4.2.4 Issues Involve Multiple Ownerships, Jurisdictions, and Scales

Many natural resource management and conservation challenges are associated with multiple ownerships, jurisdictions, and issues related to scale. As land is subdivided, the increase in landowners and decrease in tract size present the need for a wider variety of management options to meet multiple objectives. There is also a lack of management techniques to address a variety of tract sizes. Multiple jurisdictions in the same region can implement different and often conflicting policies that complicate land use and management of forest resources. Ecological concerns often exist at landscape or watershed scales but may only be addressed at much smaller scales. These challenges are addressed most effectively when efforts are coordinated across the landscape and multiple stakeholder involvement is sought.

3.4.3 Research and Information Needs

3.4.3.1 Explaining and Adapting to Human Influences on Forest Ecosystems

The effects of land conversions, forest fragmentation, pollution, and nonnative species on forest ecosystem structure, function, composition, and processes need to be better understood. Research in these areas would help us to understand these effects of urbanization and to develop management techniques for multiple small-scale ownerships. Modeling and long-term monitoring that assesses these urban effects on ecosystems are also needed.

3.4.3.2 Identifying the Influences of Public Policy on Forest Ecosystems and Their Management

The relationships among public policy, land-use change, and resulting effects on forest ecosystems are still poorly understood. Research in this area could help us understand the roles, strengths, and weaknesses of various policies that affect natural resource management and conservation in the interface. We also need information about environmental quality indicators to identify long term threats and prioritize environmental needs.

3.4.3.3 Identifying and Reducing Risk to Ecosystems and People in the Wildland–Urban Interface

Fire, invasive species, groundwater contamination, and other environmental changes can present risks for human and forest communities. Controlled experiments, historical studies, modeling, and long-term monitoring are needed so that we can better understand, predict, and avert risk.

3.4.3.4 Understanding and Communicating Public Attitudes, Values, and Perceptions

Knowledge of the diverse public preferences, values, and attitudes with respect to resource management and conservation is an important element to any natural resource program. Research in this area would help us understand how differences in age, ethnicity, and cultural background influence public use and management of forests (Figure 3.8). Natural resource managers and others could then use this information to develop effective communication strategies, education programs, and outreach messages

FIGURE 3.8 Differences in age, ethnicity, and cultural backgrounds influence public use and management of outdoor recreation areas. (Photo by Larry Korhnak.)

Demographic research could help monitor and forecast urban expansion, economic development, and resulting human influences on the landscape.

3.5 CONCLUSION

The unique conditions, challenges, and needs of the wildland–urban interface call for an integrated and adaptive approach to natural resource management. New research is required so that we can better understand changing demographics, land-use patterns, and the resulting effects on forest ecosystems and their management. A greater public understanding of the complex relationships between people and natural resources is needed, and hence innovative approaches must be developed for disseminating information to the new and diverse landowners in the interface. The Southern Center for Wildland–Urban Interface Research and Information in Gainesville, Florida, will help meet these needs by providing new interface research, technologies, outreach programs, and educational material for managers, landowners, local governments, and others. Equipped with this knowledge, people can address interface issues and make informed decisions that will affect the future sustainability of wildland–urban interface forests.

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